

Laroia 14-7-3-3

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent Application

Applicant(s): R. Laroia et al.
Case: 14-7-3-3
Serial No.: 09/503,041
Filing Date: February 11, 2000
Group: 2667
Examiner: Kwang Bin Yao

I hereby certify that this paper is being deposited on this date with the U.S. Postal Service as first class mail addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Signature: *David P. Ulpis* Date: October 13, 2004

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Title: Signal Construction, Detection and Estimation for
Uplink Timing Synchronization and Access Control
in a Multi-Access Wireless Communication System

SUPPLEMENTAL APPEAL BRIEF

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This Supplemental Appeal Brief is submitted in response to the Office Action dated July 13, 2004 in the above-referenced application, in which the Examiner reopened prosecution in response to the Appeal Brief filed April 5, 2004.

Applicants have submitted concurrently herewith a response to the Office Action, requesting reinstatement of the appeal.

REAL PARTY IN INTEREST

The present application is assigned to Lucent Technologies Inc., as evidenced by an assignment recorded February 11, 2000 in the U.S. Patent and Trademark Office at Reel 010635, Frame 0580. The assignee Lucent Technologies Inc. is the real party in interest.

RELATED APPEALS AND INTERFERENCES

There are no known related appeals or interferences.

STATUS OF CLAIMS

The present application was filed on February 11, 2000 with claims 1-47. Claims 40-47 were canceled in an amendment dated August 7, 2003. Claims 1-39 are currently pending in the application, with claims 1 and 35-39 being the independent claims.

Claims 1-39 stand rejected under 35 U.S.C. §112, second paragraph, as being indefinite.

Claims 1-6, 13, 23 and 35-39 stand rejected under 35 U.S.C. §103(a).

Claims 7-12, 14-22 and 24-34 are indicated as containing allowable subject matter.

Claims 1-39 are appealed.

STATUS OF AMENDMENTS

There have been no amendments filed subsequent to the final rejection.

SUMMARY OF INVENTION

The present invention is directed to arrangements for transmission or reception of at least one of an uplink access signal and an uplink timing synchronization signal in a wireless communication system comprising a base station and a mobile station. The “uplink” refers to communication in the direction from the mobile station to the base station. In accordance with the invention, the uplink access signal or uplink timing synchronization signal is from a signal set which includes a plurality of orthogonal signals, such that different timing and access signals from the mobile station and at least one other mobile station of the system are received at the base station orthogonal to one another over a base station sample window.

Illustrative examples of such uplink access signal and uplink timing synchronization signals are described in conjunction with FIGS. 1 and 2 of the drawings, and the corresponding text at page 6, line 7, to page 9, line 7, of the specification.

In one particular embodiment, an uplink access signal or uplink timing synchronization signal may be of the form given by Equation (1) on page 6 of the specification. As indicated on page 7,

lines 16-19, different access and timing signals use different non-overlapping sets of tone frequencies $\omega_1, \dots, \omega_M$. The tone frequencies $\omega_1, \dots, \omega_M$ and the coefficients a_m may be selected using criteria such as time resolvability or peak-to-average ratio, as is described in greater detail at page 9, line 9, to page 12, line 21.

Advantageously, the uplink access signals and uplink timing synchronization signals of the present invention are less susceptible to the deleterious effects of channel fading, multipath delay spread and interference. See the specification at, for example, page 2, lines 1-26. The invention thus provides improved performance in multiple access wireless communication systems, and more particularly in multiple access systems based on orthogonal frequency division multiplexing (OFDM).

ISSUES PRESENTED FOR REVIEW

1. Whether claims 1-39 are indefinite under 35 U.S.C. §112, second paragraph.
2. Whether claims 1-6, 13, 23 and 35-39 are unpatentable under 35 U.S.C. §103(a) over allegedly admitted prior art in view of U.S. Patent No. 6,317,412 (hereinafter “Natali”).

GROUPING OF CLAIMS

With regard to Issue 1, claims 1-39 stand or fall together.

With regard to Issue 2, claims 1, 2, 23 and 35-39 stand or fall together, claims 3 and 4 stand or fall together, claim 5 stands or falls alone, claim 6 stands or falls alone, and claim 13 stands or falls alone.

ARGUMENT

Issue 1

The Examiner argues that claims 1-39 are indefinite under §112, second paragraph, because a statement such as “transmitting at least one of an uplink access signal and an uplink timing synchronization signal from a mobile station” as recited in claim 1 is somehow inconsistent with the related claim 1 statement of “such that different timing and access signals from the mobile station and at least one other mobile statement of the system are received at the base station orthogonal to

one another over a base station sample window.” Apparently, the Examiner believes that because the first statement allows a situation in which only one of the uplink access signal and the uplink timing synchronization signal is transmitted from the mobile station, that it is inconsistent to refer to “different timing and access signals” in the second statement. Applicants respectfully submit that the Examiner is misreading the clear language of the claim. The second statement does not require that all of the “different timing and access signals” be from the mobile station that is the subject of the first statement. Instead, the second statement explicitly recites that the “different timing and access signals” are from the mobile station of the first statement and at least one other mobile station of the system. Thus, the first and second statements are entirely consistent, since the mobile station of the first statement may transmit one of the uplink access signal and the uplink timing synchronization signal, while any remaining signal or signals in the “different timing and access signals” of the second statement are transmitted by the at least one other mobile station of the system. Accordingly, the §112 rejection is believed to be improper, and should be withdrawn.

Issue 2

A proper *prima facie* case of obviousness requires that the cited references when combined must “teach or suggest all the claim limitations,” and that there be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference teachings. See Manual of Patent Examining Procedure (MPEP), Eighth Edition, August 2001, §706.02(j).

Applicants submit that the Examiner has failed to establish a proper *prima facie* case of obviousness in the present §103(a) rejection of claims 1-6, 13, 23 and 35-39, in that the allegedly admitted prior art and the Natali reference, even if assumed to be combinable, fail to teach or suggest all the claim limitations, and in that no cogent motivation has been identified for modifying the reference teachings to reach the claimed invention. Further, even if it is assumed that a proper *prima facie* case has been established, there are particular teachings in one or more of the references which controvert the obviousness argument put forth by the Examiner.

Independent claim 1 is directed to a method for use in a wireless communication system. The claim calls for transmitting at least one of an uplink access signal and an uplink timing

synchronization signal from a mobile station of the system to a base station of the system. The claim further specifies that the at least one signal is from a signal set which includes a plurality of orthogonal signals, such that different timing and access signals from the mobile station and at least one other mobile station of the system are received at the base station orthogonal to one another over a base station sample window.

As indicated above, illustrative examples of such uplink access signal and uplink timing synchronization signals are described in conjunction with FIGS. 1 and 2 of the drawings, and the corresponding text at page 6, line 7, to page 9, line 7, of the specification.

The Examiner in formulating the §103(a) rejection over the allegedly admitted prior art and Natali acknowledges that the allegedly admitted prior art fails to teach or suggest the claim 1 limitations relating to an uplink access signal or an uplink timing synchronization signal being selected from a signal set which includes a plurality of orthogonal signals, such that different timing and access signals from the mobile station and at least one other mobile station of the system are received at the base station orthogonal to one another over a base station sample window. However, the Examiner argues that these missing limitations are met by the teachings in column 5, lines 16-62, of Natali. Applicants respectfully disagree. There is no teaching or suggestion in the cited portions of Natali regarding the particular limitations in question, that is, an uplink access signal or an uplink timing synchronization signal selected from a signal set which includes a plurality of orthogonal signals, such that different timing and access signals from the mobile station and at least one other mobile station of the system are received at the base station orthogonal to one another over a base station sample window.

The particular cited portions of the Natali reference relied on by the Examiner do not relate in any way to uplink access signals or uplink timing synchronization signals, but instead relate to data transmission. This is apparent from the fact that the signals generated in the FIG. 7 transmitter are signals carrying data from data source 10. See Natali at column 5, lines 16-19. Also, the FIG. 7 transmitter relied on by the Examiner appears to be a base station transmitter, and thus the data transmission shown is in a downlink direction. This is apparent from the fact that the FIG. 7 transmitter includes a power amplifier 21, and is described as “broadcasting” the data-modulated waveforms. See Natali at column 5, lines 41-45. Moreover, it is further apparent from claims 1 and

5 of Natali that the FIG. 7 transmitter relied upon by the Examiner is indeed a base station transmitter, for data transmission on a downlink from a base station to a subscriber terminal. Accordingly, the relied-upon portions of Natali fail to supplement the fundamental deficiency of the allegedly admitted prior art as applied to claim 1.

It is therefore apparent that the allegedly admitted prior art and Natali, even if assumed to be combinable, fail to teach or suggest the limitations of claim 1 which relate to an uplink access signal or an uplink timing synchronization signal selected from a signal set which includes a plurality of orthogonal signals, such that different timing and access signals from the mobile station and at least one other mobile station of the system are received at the base station orthogonal to one another over a base station sample window.

Claim 1 thus includes one or more limitations which are not taught or suggested by the proposed combination. The combined teachings of these references therefore fail to “teach or suggest all the claim limitations” as would be required by a proper §103(a) rejection.

Also, as indicated previously, the Examiner has failed to identify a cogent motivation for combining the references or for modifying the reference teachings to reach the claimed invention. The Examiner states that it would be obvious to combine the references, or to modify the reference teachings, to reach the limitations in question because to do so would “provide an efficient communication system by increasing capacity” (Office Action, page 7, first paragraph).

The Federal Circuit has stated that when patentability turns on the question of obviousness, the obviousness determination “must be based on objective evidence of record” and that “this precedent has been reinforced in myriad decisions, and cannot be dispensed with.” In re Sang-Su Lee, 277 F.3d 1338, 1343 (Fed. Cir. 2002). Moreover, the Federal Circuit has stated that “conclusory statements” by an examiner fail to adequately address the factual question of motivation, which is material to patentability and cannot be resolved “on subjective belief and unknown authority.” Id. at 1343-1344. There has been no showing in the present §103(a) rejection of objective evidence of record that would motivate one skilled in the art to combine the allegedly admitted prior art and Natali, or to modify the proposed combination, to produce the particular limitations in question. The above-quoted statement of obviousness given by the Examiner in the final Office Action is precisely the type of subjective, conclusory statement that the Federal Circuit has indicated

provides insufficient support for an obviousness rejection. Moreover, the relied-upon portions of Natali, as described above, relate to downlink data transmission from a base station to subscriber terminals, and are therefore not readily combinable with the allegedly admitted prior art.

Accordingly, it is believed that the Examiner has failed to establish a *prima facie* case of obviousness of independent claim 1 over the proposed combination.

Independent claims 35-39 each include limitations similar to those of claim 1 as described above, and are therefore believed allowable for substantially the same reasons identified above with regard to claim 1.

Dependent claims 2-6, 13 and 23 are believed allowable at least by virtue of their dependence from independent claim 1. Moreover, one or more of these claims are believed to define additional separately-patentable subject matter relative to the proposed combination, as will be described in greater detail below.

With regard to claim 3, this claim specifies that the signal set comprises a plurality of multitone signals, with each of at least a subset of the multitone signals comprising a linear combination of tones whose baseband frequencies are integer multiples of $1/T$, where T is the base station sample window size. The Examiner again relies on column 5, lines 16-62, of Natali. However, as outlined above, this portion of Natali relates to downlink data transmission from a base station to a subscriber terminal. It provides no teaching or suggestion regarding uplink access or timing synchronization signals. The proposed combination of allegedly admitted prior art and Natali therefore fails to meet the particular limitations in question.

With regard to claim 5, this claim specifies that each timing and access signal comprises a single multitone signal with different signals using non-overlapping subsets of tones, and further that the tones from all of the timing and access signals span the total available bandwidth. Again, the proposed combination of allegedly admitted prior art and Natali does not teach or suggest such limitations. The relied-upon portions of Natali, as indicated previously, relate to downlink data transmission.


With regard to claim 6, this claim specifies that the multitone signals are transmitted with a cyclic prefix sufficiently large to cover multipath dispersion and pre-synchronization timing errors. The Examiner relies on the allegedly admitted prior art, but fails to indicate the particular manner

in which such a reference meets the claim language. Again, Applicants submit that the proposed combination of allegedly admitted prior art and Natali fails to meet the particular arrangement set forth in the claim.

With regard to claim 13, this claim specifies that the mobile station pre-computes a multitone timing and access signal and stores it in a memory associated with the mobile station. The particular pre-computation and storage operations claimed are not shown in the proposed combination of allegedly admitted prior art and Natali. The portions of Natali relied on by the Examiner do not relate to pre-computation of multitone timing and access signal as claimed.

In view of the above, Applicants believe that claims 1-39 are in condition for allowance, and respectfully request the withdrawal of the §112 and §103(a) rejections.

Respectfully submitted,

A handwritten signature in black ink, reading "Joseph B. Ryan". The signature is fluid and cursive, with the first name "Joseph" and last name "Ryan" clearly legible.

Date: October 13, 2004

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APPENDIX

1. (Previously amended) A method for use in a wireless communication system, comprising the step of:

transmitting at least one of an uplink access signal and an uplink timing synchronization signal from a mobile station of the system to a base station of the system, wherein the at least one signal is from a signal set which includes a plurality of orthogonal signals, such that different timing and access signals from the mobile station and at least one other mobile station of the system are received at the base station orthogonal to one another over a base station sample window.

2. (Original) The method of claim 1 wherein the wireless system comprises an orthogonal frequency division multiplexed (OFDM) system.

3. (Original) The method of claim 1 wherein the signal set comprises a plurality of multitone signals, each of at least a subset of the multitone signals comprising a linear combination of tones whose baseband frequencies are integer multiples of $1/T$, where T is the base station sample window size.

4. (Original) The method of claim 3 wherein the sample window size T for the timing and access signals is the same as that used in the system for OFDM data symbols.

5. (Original) The method of claim 1 wherein each timing and access signal comprises a single multitone signal with different signals using non-overlapping subsets of tones, and further wherein the tones from all of the timing and access signals span the total available bandwidth.

6. (Original) The method of claim 5 wherein the multitone signals are transmitted with a cyclic prefix sufficiently large to cover multipath dispersion and pre-synchronization timing errors.

7. (Original) The method of claim 6 wherein the cyclic prefix is larger than a cyclic prefix used in data symbols transmitted from mobile stations that are already synchronized.

8. (Original) The method of claim 1 wherein a guard time of non-transmission is added to at least one of a beginning or an end of at least one of the timing and access signals to insure that the signal does not overrun into adjacent data symbols.

9. (Original) The method of claim 1 wherein during a particular timing and access interval, the base station takes a single T -length sample of a multitone timing and access signal, where T is the base station sample window size.

10. (Previously amended) The method of claim 1 wherein the base station sample window is located within a designated timing and access interval, such that, for all possible multipath signal arrival times, the sample window captures one T -period of the steady-state sinusoidal response to the multitone signal, where T is the base station sample window size.

11. (Original) The method of claim 1 wherein a base station timing and access sample window is synchronized with a data sample window of the base station.

12. (Original) The method of claim 1 wherein the mobile station computes a multitone timing and access signal using an inverse fast Fourier transform (IFFT) that is also used for data transmission.

13. (Original) The method of claim 1 wherein the mobile station pre-computes a multitone timing and access signal and stores it in a memory associated with the mobile station.

14. (Original) The method of claim 1 wherein each of at least a subset of the timing and access signals comprises a sequence of L multitone signals transmitted sequentially, with different timing and access signals using non-overlapping subsets of tones in each of L sample windows, and

further wherein the base station takes a T -length sample from each of the L multitone signals, where T is the base station sample window size.

15. (Previously amended) The method of claim 1 wherein at least a subset of the timing and access signals comprise multitone signals, and the coefficients of a given multitone signal are selected such that a cyclic autocorrelation of the signal at delays greater than a desired timing accuracy is sufficiently small.

16. (Original) The method of claim 1 wherein at least a subset of the timing and access signals comprise multitone signals, with a given multitone signal comprising contiguous tones, such that coefficient selection for the given multitone signal can be performed using a finite impulse response (FIR) filter design procedure.

17. (Original) The method of claim 16 wherein the FIR filter design procedure comprises a Chebychev polynomial design procedure.

18. (Original) The method of claim 1 wherein at least a subset of the timing and access signals comprise multitone signals, and wherein the tone frequencies of a given one of the multitone signals are spread throughout a designated frequency spectrum for purposes of frequency diversity.

19. (Previously amended) The method of claim 18 wherein the given multitone signal comprises groups of contiguous tones, with the groups of tones separated by an amount greater than a channel coherence bandwidth.

20. (Previously amended) The method of claim 1 wherein at least a subset of the timing and access signals comprise multitone signals, and wherein the coefficients of a given one of the multitone signals are selected such that a peak-to-average ratio of the signal is minimized.

21. (Original) The method of claim 1 wherein when the mobile station transmits a timing or access signal $u(t)$, the base station uses a maximum-likelihood (ML) estimator on the received signal $y(t)$ to estimate an appropriate timing correction.

22. (Original) The method of claim 21 wherein in a multipath channel, the ML estimate is the time τ which maximizes the sum of the cross-correlation energies of $y(t)$ with certain multipath components of $u(t)$.

23. (Previously amended) The method of claim 1 wherein received signal power can be estimated in the base station by a measure of maximum total cross-correlation energy.

24. (Original) The method of claim 22 wherein the multipath components of $u(t)$ are given as the eigenvectors of an average auto-correlation of the received signal, where the average is taken over the randomness in the multipath channel and the signal noise.

25. (Original) The method of claim 22 wherein the multipath components depend only on $u(t)$ and can be pre-computed and stored by the base station.

26. (Original) The method of claim 22 wherein each cross-correlation of $y(t)$ with a multipath component can be computed using a single inverse fast Fourier transform (IFFT).

27. (Previously amended) The method of claim 1 wherein the presence of a transmitted access signal $u(t)$ can be detected by the base station when estimated received signal power surpasses a pre-determined energy threshold.

28. (Original) The method of claim 27 wherein the threshold can be adjusted to trade off false access detection probability and missed detection probability.

29. (Original) The method of claim 27 wherein the threshold can be increased to ensure that access signals are received with sufficient energy to allow accurate timing estimates.

30. (Original) The method of claim 1 wherein when re-synchronizations are sufficiently frequent, the mobile station can combine timing corrections obtained from different re-synchronization intervals to average out timing estimation errors.

31. (Original) The method of claim 30 wherein the combining can be performed by linearly low-pass filtering timing estimates received from the base station.

32. (Original) The method of claim 1 wherein the mobile station is operative to clip timing corrections received from the base station.

33. (Original) The method of claim 32 wherein the mobile station clips the corrections by ignoring timing corrections greater than a threshold.

34. (Original) The method of claim 32 wherein the mobile station clips the corrections by accepting a timing correction which is larger than a threshold only if a certain number of large values are received in succession.

35. (Original) A mobile station system for use in a wireless communication system, the mobile station system being operative to transmit at least one of an uplink access signal and an uplink timing synchronization signal from a corresponding mobile station of the system to a base station of the system, wherein the at least one signal is from a signal set which includes a plurality of orthogonal signals, such that different timing and access signals from the mobile station and at least one other mobile station of the system are received at the base station orthogonal to one another over a base station sample window.

36. (Previously amended) An apparatus for use in a wireless communication system, the apparatus comprising:

means for transmitting at least one of an uplink access signal and an uplink timing synchronization signal from a mobile station of the system to a base station of the system, wherein the at least one signal is from a signal set which includes a plurality of orthogonal signals, such that different timing and access signals from the mobile station and at least one other mobile station of the system are received at the base station orthogonal to one another over a base station sample window; and

means for generating the at least one signal to be transmitted.

37. (Previously amended) A method for use in a wireless communication system, comprising the step of:

receiving at least one of an uplink access signal and an uplink timing synchronization signal in a base station of the system from a mobile station of the system, wherein the at least one signal is from a signal set which includes a plurality of orthogonal signals, such that different timing and access signals from the mobile station and at least one other mobile station of the system are received at the base station orthogonal to one another over a base station sample window.

38. (Previously amended) An apparatus for use in a wireless communication system, the apparatus comprising:

means for receiving at least one of an uplink access signal and an uplink timing synchronization signal in a base station of the system from a mobile station of the system, wherein the at least one signal is from a signal set which includes a plurality of orthogonal signals, such that different timing and access signals from the mobile station and at least one other mobile station of the system are received at the base station orthogonal to one another over a base station sample window; and

means for processing the received at least one signal.

39. (Original) A base station system for use in a wireless communication system, the base station system being operative to receive at least one of an uplink access signal and an uplink timing synchronization signal from a mobile station of the system, wherein the at least one signal is from a signal set which includes a plurality of orthogonal signals, such that different timing and access signals from the mobile station and at least one other mobile station of the system are received at a corresponding base station orthogonal to one another over a base station sample window.

40. (Canceled)

41. (Canceled)

42. (Canceled)

43. (Canceled)

44. (Canceled)

45. (Canceled)

46. (Canceled)

47. (Canceled)